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**Road vehicles — Anti-fog coating  
for exterior lighting devices —  
Specification**

*Véhicules routiers — Revêtement antibuée pour dispositifs d'éclairage  
extérieurs — Spécification*

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## Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Road vehicles — Anti-fog coating for exterior lighting devices — Specification

## 1 Scope

This document specifies test methods and requirements for anti-fog coating of the exterior lighting devices of road vehicles.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2409, *Paints and varnishes — Cross-cut test*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 13076, *Paints and varnishes — Lighting and procedure for visual assessments of coatings*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **anti-fog coating**

coating which is able to prevent or disguise all visible fogging on the inner surface of an outer lens made of glass, polycarbonate, polymethyl methacrylate or other materials

### 3.2

#### **exterior lighting device**

lighting device which is installed outside of a vehicle working as an illuminating or signalling function

## 4 General

### 4.1 Test condition

In general, all tests in this document are carried out in a standard laboratory with an air temperature of  $(23 \pm 5)$  °C and a relative humidity of  $(50 \pm 10)$  %.

### 4.2 Test specimens

**4.2.1** All specimens shall be preconditioned at least 24 h in the air environment described in [4.1](#). The coating should be protected against mechanical damage and pollutants whenever the specimens are treated.

**4.2.2** The number of test specimens should not be less than 3 for each measurement unless otherwise specified.

**4.2.3** Test specimens can be the plates or outer lens of lighting devices with a wall thickness of (2 to 4) mm.

**4.2.4** Test specimens should be the finishes which are cured within the process recommended in the technical data sheet from paint manufacturers. There should not be any visible flaws on the coating, e.g. orange peel, inclusions, bubbles, pores, cracks, or discolorations.

### **4.3 Examination**

Perform visual examination of the coating in accordance with ISO 13076. The illumination of the observation environment shall not be less than 450 lx.

## **5 Specifications**

### **5.1 Coating thickness**

#### **5.1.1 Procedure**

Method A: technical equipment which is designed in accordance with the principle of optical interference shall be used. The refractive index specified in the technical data sheet from paint manufacturers shall be used to calculate the coating thickness.

The spacing of any two measuring points should not be greater than 50 mm and the measuring points at the border should be placed approximately 10 mm from the edge of the specimen.

In case of doubt, method B may be used as an alternative procedure.

Method B: the mean of the cross-sectioning method described in ISO 2808<sup>[1]</sup> is used for measuring the coating thickness.

#### **5.1.2 Requirement**

For the desired coating, the thickness refers to the recommended values in the technical data sheet from paint manufacturers. The thickness of all measuring points shall meet the recommended values.

### **5.2 Adhesion test**

#### **5.2.1 Procedure**

Adhesion test shall be executed in accordance with ISO 2409 using pressure-sensitive adhesive tape that has a minimum 4,5 N/cm stripping strength as per 180° peel test on steel. In order to make it easier to observe, non-transparent adhesive tape is recommended for use, such as tapes with the substrates of fabric, nylon, dacron, etc. The cutter spacing of grids should be 1 mm. The adhesive tape shall be firmly pressed onto the surface and ensure good contact with the coating before removing it.

#### **5.2.2 Evaluation**

Classification of adhesion test should not be more than Grade 1.

## 5.3 Steam test

### 5.3.1 Method A

#### 5.3.1.1 Preparation

The test area on the specimen should be greater than 50 mm × 50 mm.

The test area shall be cleaned by non-contact cleaning means before the test, such as treatment by electro-static cleaner (to remove any dust, debris or surface contaminants).

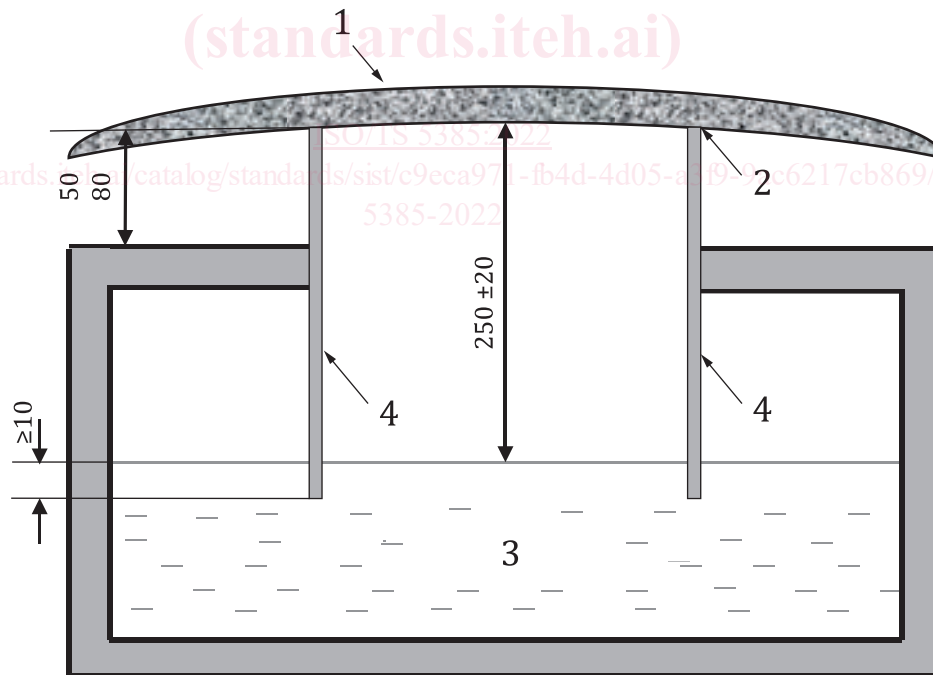
There should be minimal air flow around the test equipment while the steam test is performed.

#### 5.3.1.2 Procedure

[Figure 1](#) shows the schematic of the steam test. The distilled-water bath with the 50 mm × 50 mm air-vent is used. When the specimen is placed on the air-vent, the gap between the specimen and the wall of the air vent should be less than 1 mm. The distance from the water level to specimen should be kept at  $(250 \pm 20)$  mm. Before the test, it is necessary to mark the test area on the opposite of anti-fog coating referring to [Figure 2](#).

Heat the distilled-water in the bath and maintain it at  $(80 \pm 2)$  °C for more than 15 min with cover on the air-vent. Then remove the cover and place the specimen horizontally over the air-vent. The test area of anti-fog coating is completely exposed to the steam generated from the air-vent.

Dimensions in millimetres

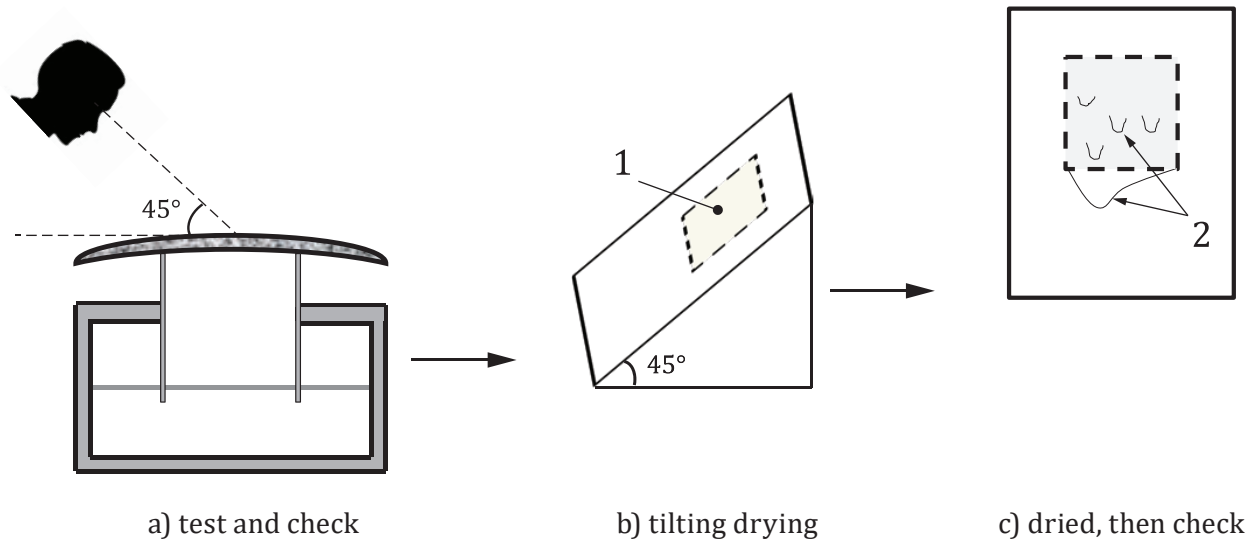


#### Key

- 1 test sample
- 2 gap, less than 1 mm
- 3 stationary distilled water
- 4 air vent

**Figure 1 — Schematic of steam test**

While exposed to the hot airflow for  $(20 \pm 1)$  s, the test area is examined by naked eyes at an angle of approximately  $45^\circ$  to horizontal. Then place the specimen on a holder with an angle of  $(45 \pm 1)^\circ$  until it is dried. Finally check flow lines on the dried specimen. [Figure 2](#) shows the process of evaluation.



- Key**  
 1 test area  
 2 flow lines

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**Figure 2 — Process of evaluation**

**5.3.1.3 Evaluation**

- 1) While the anti-fog coating is exposed to hot airflow for  $(20 \pm 1)$  s, classify the water film in test area as per following scales described in [Table 1](#). Only class 1 and 2 are satisfactory.

**Table 1 — Classification of the fogging**

No.	Levels	Description
1	Class 1	Homogeneous water film
2	Class 2	Partial non-homogeneous water film, less than 5 % of test area
3	Class 3	Partial non-homogeneous water film, more than 5 % and less than 30 % of test area
4	Class 4	Non-homogeneous water film, more than 30 % of test area

- 2) As shown in [Figure 2](#), check the dried specimen. There should be no flow lines below the test area. This recommendation only applies to the anti-fog coating in as-received condition, and it is not appropriate for the specimen after the environmental test.

**5.3.2 Method B**

**5.3.2.1 Procedure**

The test equipment in accordance with [Figure 1](#) is utilised. Keep the temperature of distilled-water at  $(40 \pm 2)^\circ\text{C}$ . While the anti-fog coating is exposed to the airflow for  $(20 \pm 1)$  s, perform visual examination of the anti-fog coating.

This method is performed only when requested.



### 5.3.2.2 Requirement

Only class 1 in [Table 1](#) is satisfactory for method B.

## 5.4 Cyclic steam test

### 5.4.1 Procedure

To determine long-term durability of the anti-fog coating, conduct the steam test [5.3.1](#) for  $(20 \pm 1)$  s. If it is in accordance with class 1 or 2 in [Table 1](#), keep the specimen leaning on a holder with an angle of  $(45 \pm 1)^\circ$  until it is dried, then repeat the steam test till the specimen tests fail.

### 5.4.2 Evaluation

The number of cycles is agreed among stakeholders. However, it should be not less than 10 times.

## 5.5 High temperature test

### 5.5.1 Procedure

Place the test specimen in a forced air oven for  $(240 \pm 2)$  h at a certain temperature. The coating should be turned away from the fan in the chamber. The storage temperature may be determined by agreements among stakeholders according to different substrates on which anti-fog coating applies. However, it should not be more than the curing temperature of anti-fog coating.

### 5.5.2 Apparatus

Unless otherwise specified, use the equipment with a temperature accuracy of  $\pm 0,5$  °C and an air flow speed  $>0,5$  m/s and  $<2$  m/s.

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### 5.5.3 Evaluation

No changes should be visible. After 30 min of acclimatization at the air condition described in [4.1](#), the test specimen should meet the adhesion test in [5.2](#) and the steam test, method A, in [5.3.1](#).

## 5.6 Low temperature test

### 5.6.1 Procedure

Place the test specimen at  $(-40 \pm 2)$  °C in the freezing chamber for  $(24 \pm 2)$  h. The coating should be turned away from the fan in the chamber.

### 5.6.2 Apparatus

Unless otherwise specified, use the equipment with a temperature accuracy of  $\pm 0,5$  °C and an air flow speed  $>0,5$  m/s and  $<2$  m/s.

### 5.6.3 Evaluation

No changes should be visible. After 30 min of acclimatization at the air condition described in [4.1](#), the test specimen should meet the adhesion test in [5.2](#) and the steam test, method A, in [5.3.1](#).

## 5.7 Condensation water test

### 5.7.1 Procedure

The test condition refers to the type of constant-humidity condensation atmosphere (CH) in ISO 6270-2<sup>[3]</sup>. The coating should be turned away from the vapour source and placed in a position allowing any water flow. The test duration shall be  $(24 \pm 2)$  h.

### 5.7.2 Evaluation

No changes should be visible. After 24 h of acclimatization at the air condition described in 4.1, conduct the adhesion test in 5.2 and the steam test, method B, in 5.3.2.

## 5.8 Environmental cycle test

### 5.8.1 Procedure

The chamber should be set to the standard condition of an air temperature of  $(23 \pm 2)$  °C and a relative humidity of  $(50 \pm 5)$  % before the test.

The coating should be turned away from the fan in the chamber and placed in a position allowing any water flow.

The environmental cycle test contains 20 cycles of temperature and humidity test as shown in Figure 3. 1 cycle lasts 12 h and comprises the following temperature and humidity phases:

- 60 min heating phase to +80 °C and 80 % RH,
- 240 min holding time at +80 °C and 80 % RH,
- 120 min cooling phase to -40 °C, when the freezing point is reached the humidity shall be approximately 30 % RH, the air humidity remains unregulated for  $T < 0$  °C,
- 240 min holding time at -40 °C, air humidity remains uncontrolled,
- 60 min heating phase to +23 °C, air humidity is regulated to 30 % RH after  $T = 0$  °C.